Iowa State Researchers Use Grants to Grow Iowa Values

State economic development dollars are helping Iowa State University researchers find ways to enhance ethanol yield, fight obesity, improve swine vaccines, improve soy biorefineries and develop other projects with commercial potential. Iowa State has awarded $788,962 from the Grow Iowa Values Fund to nine research projects. The projects are the first winners of a grant contest designed to advance Iowa State’s economic development efforts, for the benefit of all Iowans.

A committee judged the winning projects to have high potential to do one or more of the following:

• Create new Iowa businesses or jobs based on Iowa State technology
• Increase sales or profitability of Iowa companies that use Iowa State technology
• Improve the products or practices of Iowa businesses that receive assistance from Iowa State programs
• Create new Iowa State technology that can be licensed to companies with Iowa operations
• Advance collaborative research with companies that have Iowa operations

Several biotechnology-related projects were among the first round of Grow Iowa Values Fund grants. Following is an update regarding their progress:

• A grant of $73,535 has been awarded to David Grewell, an assistant professor of agricultural and biosystems engineering; Samir Kumar Khanal, a research assistant professor in civil, construction and environmental engineering; and Hans van Leeuwen, a professor of civil, construction and environmental engineering, for investigations into increasing ethanol yield from corn. The research employs high-power ultrasonication prior to or during liquefaction in dry corn milling plants to achieve better sugar release for higher ethanol yield. In traditional processing, only 33% of the potential energy of the corn is converted to ethanol. Even a marginal improvement in ethanol yield to 36% could increase the revenue generation in the Corn Belt by more than $600 million annually. The researchers are investigating ultrasound pretreatment, which generates cavitation in the aqueous phase resulting in strong hydrodynamic shear forces. The shear forces facilitate the disintegration of corn slurry into fine particles, thereby exposing a much larger surface area to enzymes during liquefaction/ saccharification. As a result, the enzymatic activity is greatly enhanced, thus improving the overall ethanol yield while reducing the required processing time and total amount of enzymes and nutrients used. Ultrasonic pretreatment of corn slurry for 40 seconds resulted in nearly a 50-fold reduction in corn particle size. The sugar yield improved by 30% in comparison to a control under the same conditions.

• Victor Lin, associate professor of chemistry; George Kraus, University Professor of chemistry; and John Verkade, University Professor of chemistry were awarded a grant of $140,000 for research into increasing the efficiency of soy biorefineries. Current biodiesel production technology reacts soy oil with methanol using toxic, corrosive and flammable sodium methoxide as a catalyst. Getting biodiesel out of the chemical mixture requires acid neutralization, water washes and separation steps, using non-reusable catalysts. The research team has developed a nanotechnology that accurately controls the production of tiny, uniformly shaped silica particles. Running all the way through
the particles are honeycombs of relatively large channels that can be filled with a catalyst that reacts with soybean oil to create biodiesel. The particles also can be loaded with chemical gatekeepers that encourage the soybean oil to enter the channels where chemical reactions take place. The results include faster conversion to biodiesel using a reusable catalyst and elimination of the wash step in the production process. The particles also can be used as a catalyst to efficiently convert animal fats into biodiesel by creating a mixed oxide catalyst that has both acidic and basic catalytic sites. Acidic catalysts on the particle can convert the free fatty acids to biodiesel, while basic catalysts can convert the oils into fuel. The particles themselves are environmentally safe because they are made of calcium and sand.

- A viral replicon particle (VRP) proof of concept trial led by Matthew Erdman, a research associate in animal science, and Maynard Hogberg, professor of animal science, has been awarded a grant of $104,064. Pigs were injected with either a VRP vaccine containing the hemagglutinin (HA) protein from influenza virus or a control VRP vaccine. The HA protein is an important virulence factor for the influenza virus and antibodies to the HA protein are known to protect against clinical disease. Although still in progress, early data has shown that the HA VRP successfully induced protective antibodies against the HA protein while the control VRP pigs remained negative. These data indicate that VRP vaccines can successfully immunize pigs against a specific antigen such as the HA protein. This research opens the door to investigate antigens from other swine pathogens such as porcine reproductive and respiratory syndrome virus (PRRSV). Ongoing work will determine the most efficient dose, route and application of the VRP vaccine technology in swine.

- Martha James; an associate scientist of biochemistry, biophysics and molecular biology; and Alan Myers; professor and chair of biochemistry, biophysics and molecular biology; have been awarded a grant of $140,000 for work to establish proof that new digestion-resistant corn starches developed at Iowa State will combat type 2 diabetes and obesity while lowering the risk of colon cancer. Maize plants have been generated that produce structurally altered starch in the kernel as a result of the over-expression of a particular starch biosynthetic enzyme. At least three independent lines were identified in which the amylopectin component of the starch has more intermediate and long length chains. This type of structural alteration is predicted to result in a more crystalline form of starch, Long-chain Amylopectin Starch (LCAPS), that is resistant to the actions of digestive enzymes. Preliminary analysis by differential scanning calorimetry (DSC) of the temperatures at which raw LCAPS gelatinizes and retrogrades indicates the gelatinization temperature is higher, supporting the prediction that this is a more crystalline starch form. In addition, enzymatic assay of LCAPS for digestibility revealed that this type of starch is digested more slowly, approximately 30% the rate of normal starch. Based on these findings, a large-scale planting of LCAPS-producing plants has been organized for summer 2006. Agronomic characteristics of these plants will be compared with those of normal plants, particularly growth rate and yield. Starch harvested from LCAPS plants will be processed by wet milling at the ISU pilot facility and incorporated into a test food product currently being developed in the laboratory of Dr. Suzanne Hendrich at ISU. This food will be used in pilot human studies in the fall of 2006 in which glycemic index measurements of LCAPS will be made in comparison with normal starches from corn and wheat.

The Grow Iowa Values Fund grant program will be funded at the rate of $5 million per year for 10 years to Iowa's three Regent universities. The deadline for grant application at Iowa State for the next round was May 1st. Grants from that group of applications will be awarded in May 2007.

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**Biotechnology News**

**Iowa State University Plant Scientists Begin to Unravel the Mystery of Hybrid Vigor**

*ISU News Service*

Researchers have uncovered a key to understanding the complex molecular mechanisms of hybrid vigor, also known as heterosis, which affects most aspects of plant growth and development. Once the gene activity behind hybrid vigor is well understood, scientists could more rapidly create hybrids that confer desired traits, like ethanol production, into the germplasm.

The research team, led by Patrick Schnable, professor of agronomy and director of the Center for Plant Genomics, includes Dan Nettleton, associate professor of statistics, and graduate students Ruth Swanson-Wagner, Yi Jia, Rhonda DeCook and Lisa Borsuk.

For the two-year experiment, the researchers used the maize F1 hybrid and its inbred parental corn lines, B73 and Mo17. The F1 hybrid is taller, matures more quickly and produces higher grain yields than both parents. They isolated RNA from each of the three genotypes and used a maize gene chip to determine the amount of RNA that accumulates for each gene in each of the three genotypes.

Using microarray technology, the researchers observed the activity of nearly 14,000 genes simultaneously. This is the first study that has looked at hybrid vigor in any crop on such a large scale.

They found that some genes are more active in the hybrid than in both of the parental inbred lines (overdominant), some genes are less active than both inbred lines (underdominant) and most genes - 78 percent - have activity levels in between the level of the inbreds (additive).

Their next step is to determine the genetic control of overdominance. “Ultimately, it is likely that we would be able to predict which specific inbreds, when crossed, would produce a strong heterotic response. To a large extent, this is now a matter of trial and error. Consequently, we might be able to develop favorable hybrids more quickly for less cost. This would result in faster genetic gain,” Schnable said.

The research was funded by the state of Iowa, Iowa State University’s Plant Sciences Institute and the Iowa Agriculture and Home Economics Experiment Station.
Iowa State University's Office of Biotechnology and the Admissions Office have released a newly revised biotechnology undergraduate recruitment brochure. Because biotechnologists work in agriculture, human health sciences, industrial processing, criminal justice and many other career areas, Iowa State University does not have a major called biotechnology. Instead, students can select a biotechnology-related major from more than 25 academic departments or programs and structure their degree program to prepare for the biotechnology career of their choice.

The revised brochure provides information about the majors and related opportunities available to undergraduate students. The brochure can be downloaded and viewed at www.biotech.iastate.edu/publications/ed_resources/Biotech_majors.pdf.

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**Upcoming Events**

**June 22-25, 2006** — Eighth Annual Plant Sciences Institute Symposium. This year’s focus: Plant Receptor Signaling. Iowa State campus. Information and registration are available online at www.bb.iastate.edu/~gfst/phomepg.html


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**Available Technologies**

Iowa State University is seeking industrial partners to develop and/or commercialize the following technologies. For more information or for a complete listing of all available technologies, contact the Office of Intellectual Property and Technology Transfer at 515-294-3893 or www.techtransfer.iastate.edu/.

ISU researchers have developed a method for regulating aptamer activity that may allow additional applications, such as monitoring gene expression or mutation detection. Aptamers are small strands of DNA or RNA that can bind to another molecule. Aptamers are attractive for both diagnostics and drug therapy because of their ability to bind with high affinity and specificity to target molecules.

Targeted Revealed Aptamer Probes (TRAPs) can be used to modulate aptamer activity. TRAPs consist of three segments: aptamer, intervening antisense and attenuator. Binding of a complementary sense sequence, such as mRNA, forces the aptamer and attenuator sequences apart and allows the aptamer to bind to its target molecule. As a result, aptamer activity is regulated by an allosteric mechanism. TRAPs permit modulation of aptamer activity, discrimination of single nucleotide differences (SNP detection) and gene expression analysis. ISURF 2711

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ISU researchers have recently identified a heat-stable enzyme that can be used to make sugar analogs more easily. These sugar analogs can subsequently be used in industrial applications, as well as in glycomics.

Nucleotide sugars created by the activity of sugar nucleotidyltransferase enzymes are critical building blocks for the synthesis of carbohydrates. However, many of known nucleotidyltransferases have a limited substrate range and lack the ability to synthesize non-natural nucleotide sugars. ISU researchers have discovered a versatile nucleotidyltransferase with applications in the chemoenzymatic synthesis of a variety of activated sugar nucleotides. This enzyme is thermostable and can accept a broad range of substrates leading to the synthesis of commercially unavailable non-natural nucleotide sugars, such as uridinediphospho (UDP)-mannose. Synthesis of sugar nucleotides using these enzymes is simple, efficient and flexible. ISURF 3302

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**Biotech Recruitment Brochure for Undergrads**

Glenda Webber, Office of Biotechnology

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**Faces and Places**

**Michael Spurlock** recently joined Iowa State as an associate professor of food science and human nutrition and holds a joint appointment in the animal science department. He received his Ph.D. in nutrition from the University of Missouri, where he studied the relationship between fatty liver and reactive oxygen species in an avian model.

Spurlock did his postdoctoral training at Purdue University, where he worked on the regulation of body composition by beta-adrenoceptor agonists. He worked with the U.S. Food and Drug Administration and Purina Mills, Inc., before returning to Purdue as an assistant professor in 1999. His research program at Purdue University was directed at developing the pig as a model for human metabolic syndrome, which reflects a pre-diabetic state that is characterized by visceral obesity, impaired glucose tolerance and a dyslipidemia. This research focused on two adipocyte-derived hormones, leptin and adiponectin, which establish strong integrated linkages among energy metabolism, adiposity and immune function. These adipocytokines are potentially very important to human health because of their relationship to obesity and its co-morbidities.

Spurlock’s research program at Iowa State continues to address the functions of leptin and adiponectin by studying adipocytes as active endocrine cells and immune response regulators, focusing on their role in relation to obesity and insulin resistance. Spurlock is working with members of the comparative medicine program at Purdue University and with Michael Sturek, Indiana University School of Medicine, to develop the Ossabaw pig as a model for metabolic syndrome in humans.

Spurlock may be reached by phone at 515-294-8730, email at mspurloc@iastate.edu, or in his office, 1109 Human Nutritional Sciences Building.

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*June 2006*
Research Update

The following are a subset of the grants recently awarded for biotechnology-related research at ISU. For more information about establishing research relationships with ISU biotechnology researchers, please contact Lisa Lorenzen at llorenze@iastate.edu.


